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ABSTRACT

A project incorporating 15 studies on parameters of cumulative programming instructional strategies in severely handicapped populations is presented. A model was developed to allow for controlled formal investigation of potentially relevant variables including those descriptive of the subject (such as handicapping condition, race, or age), the content (areas of skill or knowledge), and the task (variables related to the actual instructional process). The model allows for design of new studies based on the results of previous ones. Fifteen studies on various aspects of subject, content, and task variables are then reviewed and data are presented in table form. (CL)

FINAL REPORT

PARAMETERS OF CUMULATIVE PROGRAMMING WITH SEVERELY/PROFOUNDLY HANDICAPPED PUPILS

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Table of Contents

OBJECTIVES AND NEED FOR THIS ASSISTANCE

Special education is currently facing a dilemma brought about, in part, by legislative mandates to provide services to the severely/profoundly handicapped (SPH), while much of the information needed to provide these services is incomplete. Historically, very few public schools or institutions have provided much more than custodial care for the severely/profoundly retarded, multihandicapped population. In fact, the provision of publicly supported special education services to the mentally retarded has been marked by a concentration of effort in behalf of those most competent, while the severely and profoundly retarded have been systematically excluded and placed in institutions where little or no programming was available. In the 1960's less than 5% of the nation's retarded were in institutional settings (Butterfield, 1969; Dingman & Tarjan, 1960), while about half the nation's profoundly retarded were institutionalized.

Recent court decisions and the civil rights nature of the Education of All Handicapped Children Act of 1975 (Public Law 94-142) already have initiated and will continue the implementation of services f r all handicapped children in the least restrictive environment possible. The litigation and legislation is helping to remedy the situation described above by making services available to previously unserved populations and perhaps even more important, by making sure the services are appropriate. As Abeson and Zettel (1970) point out:

"There simply will not be any grounds for depriving a

> handicapped child, who because of that handicap, possesses unique learning needs requiring special education. No longer will it be permissible for a school person to exclude or postpone the education of such handicapped children on the grounds that they cannot learn, their handicap is too severe, programs do not exist, or for any other reason . . . it means that no child is uneducable or stated in another way, all children can learn." (p. 122)

We not only have to take this statement seriously, we also must take it literally. Responsibility for insuring success in these efforts fall in two major areas: (a) delivery agencies (e.g., public schools, institutions, etc.) and (b) training agencies (e.g., universities, colleges, etc.). Two problems emerge when educational efforts are directed at the severely handicapped. One problem is that of breaking new ground. The second problem involves systematically testing existing knowledge and techniques on this heretofore unserved population. Our previous educational efforts with the SPH were mostly based on intuition. That intuition, at best, was based on our previous experience. According to Haring and Pious (1977):

> "--it is our responsibility as educators to teach and to demonstrate unmistakably to the public that severely handicapped persons can learn.
>
> We are beginning to recognize some of the instructional components necessary for the undertaking of educational responsibilities mentioned earlier . . . the procedures that educators have developed in their work with moderately handicapped children will have to take a quantum leap; what we now consider sophisticated skills may well seem primitive as we develop the instructional competencies necessary to teach our new educational clientele . . ." (p. 5-6)

There is no question that special education is "tooling up" to meet the educational needs of the severely handicapped. The question

is in what areas or toward which objectives do we invest our resources? In the past few years there have been some programmatic efforts at identifying knowledge which would be of benefit to severely handicapped populations. In general, these program can be classified into two broad categories: investigations of operant procedures with severely handicapped subjects and development of curricula for severely handicapped populations.

The first program was essentially designed to demonstrate the law of effect across many different behaviors in severely handicapped populations. Different operant procedures that were investigated all depended on the law of effect for their theoretical base, thus their success or failure was not really a test of the law of effect but instead a gauge of the effectiveness of the reinforcer used. In essence then, most of these studies dealt with incentive motivation questions (Siegel, 1968). They answered questions involving the relative efficacy of various reinforcers and the relative preference of the subjects for them. Some recent examples of this include the preference of vibratory over visual stimulation by severely and profoundly retarded subjects (Ohwaki, Brahlek, and Stayton, 1973; Ohwaki & Stayton, 1976) and the use of contingent vibratory stimulation to train nonambulatory profoundly retarded students (Murphy & Doughty, 1977; Zucker, D'Alonzo, McMullen & Williams, in press).

The second program was geared toward generating systematic and specific curricula to meet the needs of severely handicapped populations. The focus of these programs was to use interdisciplinary and practitioner input for generation of competencies applicable to

the severely handicapped. Evidently, this program has been quite successful as indicated by the dissemination of many books, reports and guides on curriculum for the severely handicapped (e.g., Donlon & Burton, 1976; Sontag, 1977). These documents address topics ranging from general content areas such as communication and self-help to specific objectives for eye movements and tongue positions. The feature which is most noticable in the majority of these curriculum specification efforts is that they are not watered down versions of curriculums for moderately retarded children. Rather, these curricula are directed solely toward training areas which relate to SPH populations.

Notwithstanding the accomplishments of the above programs, there seems to be a major gap in our research efforts at elucidating information applicable to severely handicapped populations. The focus of research must change from what to teach to how to teach. Answering the how to teach question by identifying additional reinforcers or novel ways in which they may be applied is circumventing the question. Haywood (1977) stated:

> "We do not need any more studies of single subjects designed to demonstrate that the law of effect still works and can be applied to yet another aspect of behavior. The law of effect is as valid today as it was in 1927." (p. 315)

Generating more curriculum, even appropriate curriculum, does not answer the process question of how to achieve the competencies. One example would be a recent special publication of the Division on Mental Retardation of the Council for Exceptional Children (Sontag, 1977). This volume entitled "Educational Programming

for the Severely and Profoundly Handicapped" devotes very little actual space to the "how to" question. While many of the articles have provocative titles, close inspection reveals they are generally curricular descriptions. Implementation is generally assumed to be operant in nature. For example Bricker and Iacino (1977) relate this process:

> "The next stage is systematic implementation which may be largely dependent upon the personnel's knowledge of and skill in using teaching strategies based on behavioral principles." (p. 175)

The important point to be gleaned here is that operant techniques cannot substitute for instructional strategies. These two dimensions are not interchangeable, they are complementary. Operant techniques are only as good as the instructional strategy which determines their use. The rewarding and often dramatic results that are accomplished using operants with severely handicapped populations should not limit our investigations and development of appropriate instructional strategies which would further enhance our success. It is only through research that we can systematically test existing strategies and based on the results develop new ones to be further tested. Haywood (1977) emphasizes that:

> "We need basic research on the fundamental mechanisms by which human beings learn. We need somewhat more complex research on the interactions among learning strategies, personal characteristics of individuals, types of material to be learned, settings for learning, and incentive conditions." (p. 316)

The identification and investigation of learning strategies would seem to be of paramount importance if we wish to meet the needs of low functioning children. In discussing the learning

performance of mildly handicapped students, Prehm (1976) has indicated that handicapped children fail to use learning strategies spontaneously and that we should correct this by teaching the strategy along with the information to be learned. Learning strategies in this sense are techniques used to help people remember and use information. Providing learning strategies for severely handicapped populations which effectively enhanced learning would fill the gap mentioned earlier between operant procedures and curriculum implementation.

One learning strategy approach which has been used with non-handicapped students is called cumulative programming. Becker, Engelmann and Thomas (1975) define cumulative programming as follows: ". . . two concepts from a related set are brought to criterion. Then new concepts are added one at a time and brought to criterion." (p. 257) The use of this program as a method of instructio. as been explored by a few researchers. A brief review of these studies follows.

Carnine (1976) demonstrated the effectiveness of introducing similar sounding stimuli cumulatively in a letter-sound correspondence task. The study was conducted with three groups of normal preschool children. In one group the stimuli were presented simultaneously, i.e., all the stimuli were on the same presentation sheet. For this group, the similar sounding letters, e and i, were introduced separately with four letters in between each presentation. The stimuli were presented to the other two groups cumulatively, i.e., a new letter was added to the set of previously learned letters only when the child had reached criteria on all the letters in the current set. For one of the cumulative introduction groups,

the similar sounding stimuli were presented together, i.e., i followed e. The similar sounding stimuli for the other cumulative introduction group were separated, i.e., e and i were presented with four other letters in between. The findings indicated that the cumulative introduction group in which the similar sounding stimuli were separated reached criterion more quickly than the other two groups. Also, posttest scores for both cumulative introduction groups were higher than the simultaneous group's posttest scores.

Staats, Brewer & Gross (1970) studies alphabet reading in 11 preschool children. The letters were presented sequentially in upper-case form. Pictures, used early in the program, were eliminated when the child could identify several letters. When a new letter had been mastered, it was presented in sequence with several previously learned letters, i.e., for P the sequence would be L M N O P. When the child learned the letter in sequence, it was randomly presented with all the earlier letters in the alphabet, thereby constantly reviewing those letters. The results demonstrated that the use of this type of cumulative programming strategy resulted in the children's acquisition of the letters at an increasingly faster rate, i.e., they required fewer trials to master the second half of the alphabet (N-Z) than were required to master the first half of the alphabet (A-M).

Ferster & Hammer (1966) used a cumulative programming strategy to teach <u>chimpanzees</u> binary arithmetic. They compared successive pairs and cumulative programming strategies on a number-symbol paired

associate learning task. The experimenters found that discrimination of randomly presented numbers was accurate when cumulative programming was used but when successive pairs programming was used, the animals only responded at a chance level to randomly presented numbers.

Gruenenfelder & Borkowski (1975) tested the spontaneous transfer of cumulative rehearsal during serial learning to a new list. They divided 60 normal first grade children into two groups: (a) no instruction; and (b) cumulative rehearsal. From the data reported, the authors concluded that some of the children in the second group did not use the cumulative rehearsal strategy spontaneously after training. The serial lists (three 9-item and one 4-item) were slides constructed using pictures from the Peabody Picture Vocabulary Test. The children who used cumulative rehearsal needed fewer trials to reach criterion than the other two groups (those with no instruction and those who received cumulative rehearsal instruction but did not spontaneously transfer it after training). The cumulative rehearsal group took a significantly longer time to reach criterion. The time measure was contaminated because each subject in the study controlled the length of stimulus item exposure time. Subjects in the cumulative rehearsal group held items for significantly longer exposure periods. The children who were instructed with cumulative rehearsal were able to transfer their learning to a new serial list a week later where no instructions were given.

Up to this point the studies cited have employed intellectually normal children. There have been two studies, however, which investigated cumulative programming strategies with moderately and severely

handicapped children. Fink and Brice-Gray (1979) conducted a pilot study investigating cumulative programming with 10 moderately and severely handicapped preschoolers. Half the subjects were assigned to a successive pairs programming group while the other half were assigned to a cumulative programming group. The results indicated that subjects who received the cumulative programming instructional treatment reached terminal criteria in significantly less trials than the subjects who received the successive pairs programming instructional treatment. Also, subjects in the cumulative programming instructional treatment made significantly more correct responses on an immediate recall measure than did the successive pairs programming instructional treatment group.

Prehm, Zucker and Roth (1979) also tested the cumulative programming paradigm, this time with severely and moderately retarded school age children. They found subjects in a cumulative programming group required less trials to reach criteria than did a successive pairs group. Unlike Fink and Brice-Gray (1979), however, immediate recall did not differ between groups. On seven day recall the cumulative group performed significantly better than the successive group.

The studies reviewed above using intellectually normal and primate populations certainly reveal the potential utility of cumulative programming strategies for teaching. Especially promising are the salutory effects reported by Fink and Brice-Gray (1979) and Prehm, Zucker and Roth (1979) in handicapped populations. These positive results and the alarming dearth of other evicence in this area clearly call for more research, on a larger scale, which will systematically identify, investigate and validate cumulative programming strategies and the associated parameters which interact with them.

Goal and Objective

The major goal of this project is to investigate the parameters of cumulative programming instructional strategies in severely handicapped populations. Realization of this goal will result in pragmatic techniques which will have direct and immediate application to training in these populations.

The major objectives which will accomplish this goal are:

1) investigation of variables descriptive of the subject;

2) investigation of variables descriptive of the content;

3) investigation of variables descriptive of the task.

In order to facilitate systematic exploration of these variables, the following Model has been developed (Figure 1 on page 17). This Model (adapted from Altman, 1973; Alt[illegible] [illegible]alkington, 1971) will allow for controlled formal investigation [illegible] [illegible]ntially relevant variables including: (a) those variable[illegible] [illegible] of the subject; (b) those variables descriptive of the conte[illegible] (c) those variables descriptive of the task. The list of variables comprising the dimensions of this Model is not meant to be exhaustive. The list will serve as the starting points for the beginning studies. Variables may be deleted or added to the Model as deemed necessary depending on the results of our explorations.

The Subject Variables of this model will allow us to ask questions related to the effects of cumulative programming techniques on different handicapped populations. For example, there may be differences between severely and profoundly retarded, or between retarded and autistic, or between ambulatory and non-ambulatory, etc. Chronological age of the child may be a factor as could be sex or race. In addition, whether or

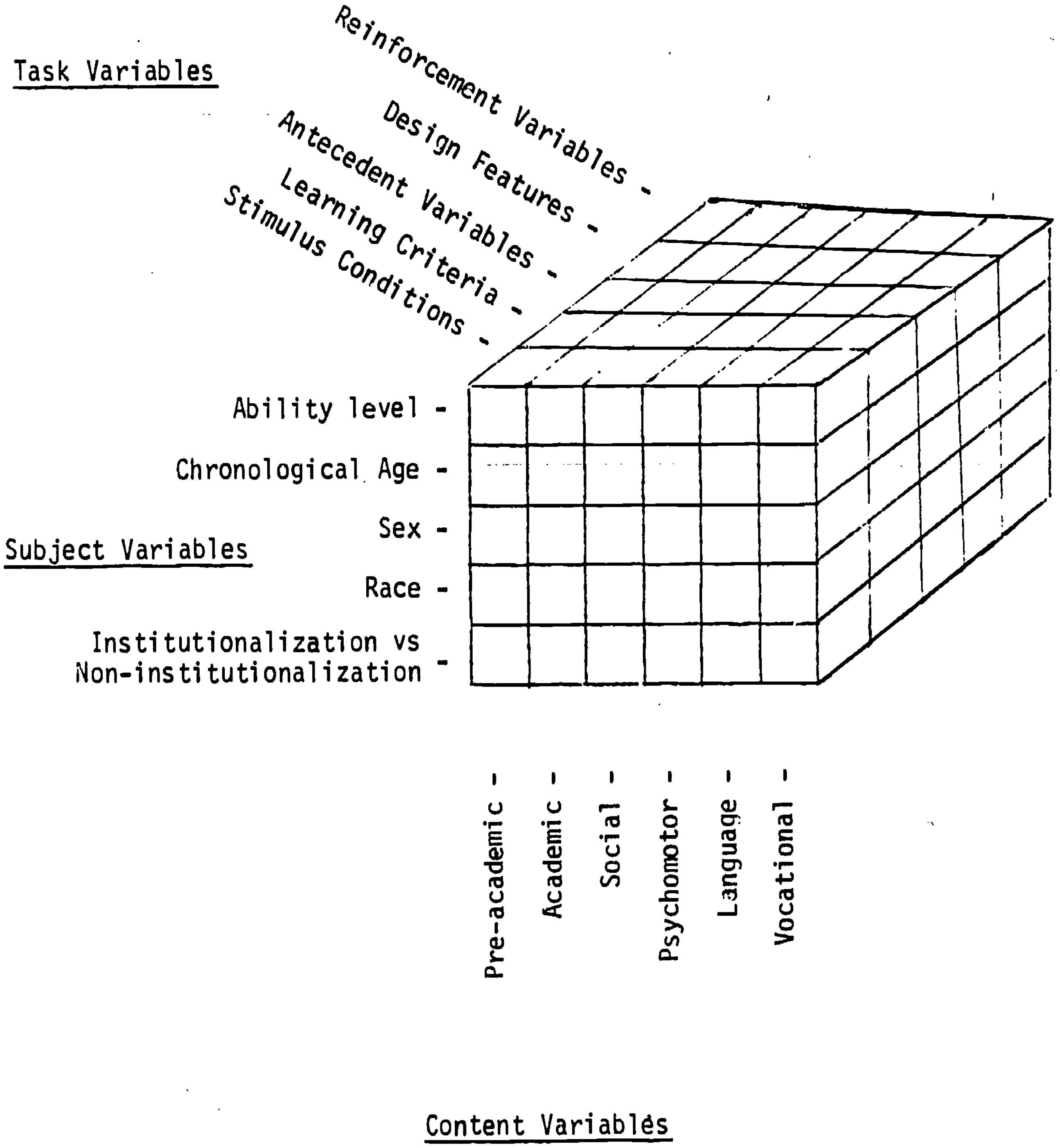

Figure 1 - Dimensions identifying cumulative programming parameters

not the child resides at home or in an institution may be related to success at certain tasks. Subject variables then, are those characteristics of children which may effect the outcome of the instructional technique.

Content variables refer to the different areas of skill or knowledge we would be training. While it is obvious that cumulative programming techniques may enjoy differential success across these areas it is also possible that dimensions within these may also effect outcomes. For example, in the pre-academic area do cumulative instructional strategies work equally well for recognition of shapes as opposed to beginning number concepts? For academics the same questions could be asked about reading and math skills. Social areas might involve differences between one-to-one skills as opposed to group skills. Psychomotor (locomotion vs. fine motor), language (receptive vs. expressive) and vocational (assembly vs. sorting) areas also lend themselves to these kind of questions.

Task variables reflect areas related to the actual instructional process. The interaction of this dimension with the other two may differentially effect cumulative programming outcomes. For example, consideration of the reinforcement variable would involve the efficacy of cumulative programming under reinforcement vs. no reinforcement. Also subsumed under this category would be the relative effectiveness of alternate reinforcers (e.g. social vs. edible). Under design features such questions such as group or individual instruction could be considered. The category of antecedent variables would include items such as previous experience with the content and current skill level. Learning criteria refers to

a "barometer" of success which may differentially vary from a certain number of correct responses to generalization to other settings or different tasks. Finally, stimulus conditions refers to the number, rate of presentation, order of presentation, etc. of stimuli in the cumulative programming instructional sequence.

Thus the subject, content, and task variables outlining the dimensions of this Model comprise the possible parameters which interact with cumulative programming. At first inspection it may appear that each cell of the Model represents a study in itself. Closer examination, however, reveals that each cell represents many separate studies within those relevant dimensions. We have the option of manipulating the variable dimensions while testing cumulative programming or holding the dimensions constant while comparing cumulative programming to another type of programming, or doing both simultaneously. Many times these decisions will be based on the number of subjects that are available from each category. One example of this would be the cell defined by the intersection of reinforcement under Task Variables, ability level under Subject Variables, and vocational under Content Variables. These dimensions suggest a variety of studies one of which might be the effectiveness of cumulative programming with three types of reinforcers (e.g., edible, social, and vibratory), on two types of vocational task (e.g., sorting and assembly) on the learning/ performance of severely handicapped children (e.g., profoundly retarded and autistic). Or, we could hold the dimensions constant and vary the type of instructional strategy (e.g., cumulative programming and successive programming), or, we could simply add this fourth factor of instructional programming to the previous three dimensions. What would determine

the specific elements of a given study would be the number of subjects available and the specific questions under investigation.

It is obvious that the model depicted could be used to generate a seemingly endless number of studies. In order to limit the scope of our studies we have a number of high priority variables which would receive early attention. Specifically, along the content dimension we would highlight pre-academic and academic variables, along the subject dimension we would highlight ability level and chronological age variables and along the task dimension we would highlight stimulus conditions and learning criteria variables. These variables seem most relevant based on previous research and pragmatic value in the classroom. Thus, our initial series of studies will concentrate on these factors and the results of these studies will aid in the choice of subsequent investigation variables from our model.

RESULTS OR BENEFITS EXPECTED

As indicated in the preceding section, there is very little available knowledge related to the effectiveness of various instructional strategies with SPH children. Educational efforts are dependent upon the teachers' knowledge of reinforcement techniques and rather standardized programming techniques. The effectiveness of alternative programming techniques, particularly as these techniques effect the learning of SPH children, is not known. If teachers are to make sound instructional judgments, evaluations of the parameters of potentially powerful educational programming techniques are needed.

This three year project is designed to fill a void in our knowledge of effective instructional programming for SPH individuals. Completion of the project will provide teachers of the SPH and program planners with extensive information regarding the cumulative programming instructional

strategy. The knowledge gained through the proposed project can be used to plan curricula, to design specific instructional activities, and to implement actual instruction. Through this project more effective and efficient instruction for the SPH will be developed. The primary benefits of the proposed project will be the increased skill levels of (a) the pupils involved in the project and (b) the pupils taught by persons using the results of the project. Additional benefits will be increased ability of educators to design effective instructional programming strategies for SPH children.

APPROACH

Plan of Action

The specific and general procedures to be detailed are to be considered generic to all studies to be conducted in the research program. The model presented allows us to pick variables and construct investigations based on the actual results of our ongoing studies. This method is preferred to one which specifies in advance the exact dimensions of each individual study. It may be that certain dimensions of the model will give us more useful information, thus, a flexible approach can capitalize on this. The purpose of the following description is to outline the procedures which will be used independent of the variables under investigation. The variables used here are examples taken from the subject, task, and content model.

The purpose of this sample study is to investigate the relative efficacy of two instructional strategies (e.g. cumulative and successive pairs programming) under two types of reinforcement (e.g. social and edible) on the learning of two-syllable functional sight words by severely

retarded and autistic children. Referring back to our model, this study would be varying two of the dimensions (task and subject) while holding the third constant (content) and adding and varying a fourth (instructional strategy). This demonstrates the flexibility available in structuring and investigating research questions.

Subjects

Severely retarded and autistic subjects will be randomly selected from their respective populations. Severely retarded subjects will be randomly assigned to one of four treatment conditions as will autistic subjects, thus, constituting eight total conditions. After assignment, subject characteristics such as age, sex etc. will be statistically compared to check on differences between conditions. It is anticipated that 10 subjects per condition will be required to satisfy general subject/variable ratio requirements. Numbers of subjects may be a factor but, in general, the greater Phoenix area has many public and private facilities which serve severely handicapped children. Many of these have cooperated in the past with either funded or individual projects and a sample of these have responded favorably to our current inquiries.

Procedure

Each subject will be run individually in a predetermined random order each day. The experimental session will take place in an available room in the student's school. Essentially, this room will be minimally distracting and contain a table and chairs for the experimenter and subject. The subject will sit across the table from the experimenter. The stimuli will be five two-syllable functional sight words (e.g.,

entrance, women, danger, exit, and poison) presented individually on 13 x 20.5 cm cards, randomly ordered from a through e. All stimuli used will be novel to the subjects.

Instruction will begin with stimulus a. The experimenter will present stimuli a and b to the subject and touch stimulus a and say, "This is _____. Touch _____." If the subject responds correctly, i.e., touches the correct stimulus, the experimenter will immediately reinforce the subject with praise or edibles, depending on which reinforcement treatment condition the subject is in. If the subject responds incorrectly, the experimenter will immediately say, "No, this is _____ (and touch the correct stimulus). Touch _____." The experimenter will then switch the left-right position of the stimuli and instruct the subject to touch the stimulus again. The order of the arrangement of the cards will be randomly determined prior to the beginning of the study. The subjects will be given twenty trials per day or the number required to reach criterion if less than twenty. Training will continue until the subject reaches a criterion of eight consecutive correct responses. When the subject reaches criterion on stimulus a, the experimenter will follow the same procedures to teach stimulus b. This would be step 2.

In step 3, the subject will discriminate stimulus a from stimulus b. The experimenter will present both stimuli to the subject and instruct the subject to identify one stimulus at a time. For each trial, the experimenter will follow the order of switching stimuli referred to in step 1 and instruct the subject to choose stimuli in the order given on the data sheets in Appendix A. From this point on,

the training will differ depending on instructional condition.

For the next twelve steps the subjects in the <u>successive pairs</u> instructional programming group will be instructed as follows: the next single stimulus will be introduced with stimulus a and brought to criterion. Then, that stimulus will be discriminated from stimulus a. This procedure will continue until all single stimuli had been introduced and all possible pairwise discrimination are made by the subject.

For the next six steps the subjects in the <u>cumulative instructional</u> programming group will be instructed as follows: the next single stimulus will be introduced and brought to criterion with stimuli a and b, i.e., the subject will only have to identify the new stimulus. Then the subject will be required to identify the new stimulus as well as a and b. This procedure will continue until all single stimuli have been introduced and all possible stepwise discriminations have been made (see Appendix A). Subjects will be required to respond with at least 75 percent correct accuracy on previously learned stimuli after moving beyond stimulus c (step four) i.e., in step five, when the subject is required to identify stimuli a, b, and c, the subject could get 75 percent correct response or six-out-of-eight on a and b until the subject correctly identifies stimulus c eight consecutive times.

When a subject has reached criterion on the last step of his respective program, a test will be administered. The experimenter will place all five stimuli on the table in front of the subject. Then, following the random order given on the data sheets in Appendix A,

the experimenter will instruct the subject to touch each stimulus. The subject's responses will be recorded. In addition to this data the experimenter will also record responses to each step of the instructional program on the data sheets. This will allow tabulations of the total number of trials each subject takes to reach criterion.

Analysis

The data will consist of scores on two dependent measures (trials to criterion and number correct on test) which reflect the dependent variables of rate and recall. The statistical technique that will be used to analyze the data and test appropriate null hypotheses will be a three-way (reinforcement x subject x strategy) multivariate analysis of variance (MANOVA) (Anderson, 1958; Morrison, 1967; Tatsuoka, 1971). Using the MANOVA reduces the possibility of a spurious rejection of null hypotheses, which increases when spearate analysis of variance (ANOVA) tests are performed for each of the dependent measures. The MANOVA can yield a number of criteria to test effects and interactions. These include Hotelling-Lawley's Trace, Pillai's Trace, Wilks" Likelihood Ratio Criterion, and Roy's Maximum Root Criterion (Heck, 1969; Pillai, 1960; Schatzoff, 1966). The first two can yield approximations of the F distribution while the latter two are based on their own distributions. The evidence available at present does not indicate any superiority of one criterion over any other (excluding computational factors) for the purposes of this study (Ghosh, 1964; Kshirsager, 1972; Mikhail, 1965; Pearson, 1971, Pillai & Dotson, 1969; Pillai & Jayachandran, 1967; 1968).

If the MANOVA indicates rejection of any of the null hypotheses, then separate univariate ANOVAs will be performed on each dependent

measure. In addition, where indicated, post-hoc Newman-Keuls comparisons will be used to indicate differences between means across conditions and simple or simple simple effects will be ascertained for significant interactions (Steel & Torrie, 1960). The probability level for rejection of all null hypotheses will be .05.

It should be emphasized that following these procedures and based on the results, new studies will be designed and investigations of the parameters of cumulative programming will continue. It is anticipated that from three to five such studies can be conducted each year for the three year grant period. By utilizing the overall model and approach described above, the researchers can capitalize on the results of each of the experiments.

Projection of Accomplishments

It is anticipated that from 70 to 120 SPH persons (preschool, school age, and adolescents) will participate in project activities during each of the three years of the research program. The Phoenix metropolitan area has sufficient numbers of SPH persons to support the research program proposed. Criteria consistent with the AAESPH definition of SPH persons will be used as the basis for selecting the subjects to participate in the project.

The proposed project is projected for a three year period. Projected accomplishments of the project are listed below.

Year 1

July - September 1980

Select parameters for study for first three experiments

Develop materials

Select subjects

Hire Graduate Assistants

October - December 1980

Conduct Study 1

Begin Study 2

Submit proposals for dissemination at conferences and workshops

Prepare continuation request

January - March 1981

Conduct Study 2

Conduct Study 3

April - June 1981

Complete all Year 1 studies

Write final report of Year 1 activity

Design Year 2 Studies

Make appropriate presentations

Year 2

July - September 1981

Conduct Studies 4 and 5

Submit proposals to appropriate professional organizations for conference presentations

October - December 1981

Conduct Studies 5 and 6

Prepare continuation request

January - March 1982

Conduct Studies 6 and 7

Conduct one local dissemination workshop

April - June 1982

Conduct Studies 7 and 8

Make two national conference presentations

Conduct one local dissemination workshop

Complete all Year 2 activities

Year 3

July - September 1982

Write report of Year 2 activity

Design Year 3 Studies

Submit professional meeting presentation proposals to relevant professional organizations

October 1980 - March 1983

Conduct Studies 9 - 12

Conduct local dissemination workshops three, four and five

Make appropriate conference presentations

April - June 1983

Conduct dissemination workshops six and seven

Complete Year 3 activity

Make appropriate conference presentations

Write final report

The benefits to be derived from this project are clear in terms of their impact on handicapped children. The results of clarification, validation, application and implementation of cumulative programming techniques tested in this research program and their related parameters can be immediately utilized in educational applications for the severely handicapped. There will be no research to practice lag in implementing these findings. The research program proposed here is entirely pragmatic in nature, it involves application of teaching strategies to various

children across various tasks and areas.

The dissemination plan involves much more than the typical research presentations at national conferences and publication in relevant journals. While these are important areas of dissemination, the time lag between exposure and implementation with children is too great. Therefore, in addition, project staff will conduct a series of dissemination workshops throughout the state for public and private agencies dealing with severely handicapped children. These workshops would enable immediate implementation of the findings by these respective agencies. In this way, over 1000 severely handicapped children would directly benefit from this project while many more would benefit indirectly.

Also, this same type of approach (dissemination workshops) is planned for the national level. Organizations such as The American Association on Mental Deficiency and The American Association for the Education of the Severely and Profoundly Handicapped sponsor special courses and workshop sessions at their national meetings which are practitioner oriented. We would submit proposals to conduct these types of activities, thus enhancing the probability that our findings would be implemented at a national level.

ACCOMPLISHMENTS

Using the timeline presented in the previous section as a reference, the following study descriptions will indicate that we have completed all project activities. All studies described below followed the general experimental procedures detailed earlier in this report. Data analysis was accomplished using a Mann-Whitney U test. The parametric analyses previously described were abondoned due to the small size of each study. It was decided that the non-parametric test would be much more robust in giving us accurate information regarding group differences.

Study 1

This study was conducted at Loloma School in Scottsdale. We compared cumulative and successive programming for teaching sight words to elementary severely retarded subjects, thus, it was a replication of Prehm, Zucker and Roth (1979). Data are presented below in Table 1. The data analysis indicated that cumulative programming was superior to successive programmong on the number of trials to criterion ($p=.05$), on the one-day post-test ($p=.05$) and on the seven-day post-test ($p<.05$).

Study 2

This study was conducted at the Arizona Preschool for Retarded Children in Phoenix. We compared cumulative and successive programming for teaching sight words to severely retarded preschool subjects, thus, it was areplication of Fink and Brice-Gray (1979). Data are presented below in Table 2. The data analysis indicated that cumulative programming was not superior to successive programming on the number of trials to criterion ($p>.05$) or on the one-day post-test ($p>.05$). However. on the seven-day post-test, cumulative was superior to successive ($p=.05$).

TABLE 2

Cumulative

Subject	Trials[a]	P1[b]	P2[c]
1	10	8	10
2	16	8	9
3	17	8	10
4	17	9	10
5	28	10	10
6	34	10	10
	$\bar{X}$ 20.33	$\bar{x}$ 8.33	$\bar{X}$ 9.83

Successive

Subject	Trials[a]	P1[b]	P2[c]
1	16	3	4
2	16	4	5
3	37	5	7
4	49	9	9
5	78	10	10
	$\bar{X}$ 39.20	$\bar{X}$ 6.20	$\bar{X}$ 7.00

a = blocks of twenty
b = one day posttest
c = seven day posttest

Study 3

This study was a comparison of cumulative programming across age levels on an academic task. This was accomplished by comparing the cumulative group from Study 1 with the cumulative group from Study 2. In other words, we have two cumulative groups learning sight words witn the only difference between the groups being age of the subjects. The data are presented below in Table 3.

The data analysis indicated that cumulative programming was differentially effective across age levels. While there were no significant differences between pre-school and elementary age students on one-day and seven-day post-tests, the preschool students took significantly more trials ($p < .05$) to reach criterion than the elementary age group.

Study 4

This study was conducted at the Arizona Preschool. We used cumulative programming to teach the names of colors to a group of eleven preschool severely retarded subjects. The school year ended before we could complete data collection.

Study 5

This study was conducted at Loloma School. Seven severely retarded elementary subjects were instructed with cumulative programming to teach them manual signs for practical words. Data from this task will be compared to the cumulative data from Study 1 to ascertain differences between psychomotor and non-motor academic tasks.

TABLE 3

Cumulative Programming

Elementary

Subject	Trials[a]	P1[b]	P2[c]
1	29	10	10
2	20	4	6
3	20	10	9
4	18	8	10
5	12	9	9
6	11	7	8
7	10	10	10
8	10	10	7
9	9	10	10
10	9	10	10
11	9	10	10
	$\bar{X}$ 14.27	$\bar{X}$ 8.91	$\bar{X}$ 9.00

Pre-School

Subject	Trials[a]	P1[b]	P2[c]
1	10	8	10
2	16	8	9
3	17	8	10
4	17	9	10
5	28	10	10
6	34	10	10
	$\bar{X}$ 20.33	$\bar{X}$ 8.33	$\bar{X}$ 9.83

a = blocks of twenty
b = one day post-test
c = seven day posttest

Additional data for this study were collected from subjects in Study 14. The data and results are presented under Study 14.

Study 6

This study was conducted at Loloma School. Ten elementary severely retarded subjects were instructed with cumulative programming to teach them sight words using 100% as the criterion for learning. Data from this task was compared to the cumulative data from Study 1 (where the learning criterion was 80%) to ascertain differences attributable to c anges in learning criteria. Data are presented below in Table 4. The data analysis indicated no significant differences between the two learning criteria groups ($p > .05$).

Study 7

This study was conducted at CIDS/ESP housed at Papago School in Phoenix. Sixteen elementary age profoundly retarded subjects with multiple handicaps were taught the names of common objects using the cumulative programming technique. The study was discontinued after 80 days. No subjects were progressing toward criterion.

Study 8

This study was conducted at Loloma School. Six elementary severely retarded subjects were instructed with cumulative programming to teach them manual signs for practical words to 100% criteria. These data were compared to the data from Study five where the criterion was 80%. Data are presented below in Table 5. The data analysis

TABLE 4

Cumulative Programming

80%

Subject	Trials[a]	P1[b]	P2[c]
1	29	10	10
2	20	4	6
3	20	10	9
4	18	8	10
5	12	9	9
6	11	7	8
7	10	10	10
8	10	10	7
9	9	10	10
10	9	10	10
11	9	10	10
	$\bar{X}$ 14.27	$\bar{X}$ 8.91	$\bar{X}$ 9.00

100%

Subject	Trials[a]	P1[b]	P2[c]
1	10	10	10
2	10	9	10
3	13	10	7
4	10	10	8
5	10	10	9
6	9	10	10
7	9	8	7
8	10	10	10
9	11	10	10
10	18	8	7
	$\bar{X}$ 11.00	$\bar{X}$ 9.50	$\bar{X}$ 8.80

a = blocks of twenty
b = one-day post-test
c = seven-day post-test

TABLE 5

Cumulative Programming

100%

Subject	Trials[a]	P1[b]	P2[c]
1	13	10	8
2	10	10	10
3	9	9	9
4	9	10	9
5	9	10	9
6	9	10	10
	$\bar{X}$ 9.83	$\bar{X}$ 9.83	$\bar{X}$ 9.17

80%

Subject	Trials[a]	P1[b]	P2[c]
1	31	9	10
2	18	10	10
3	33	9	9
4	12	8	10
5	17	9	10
6	15	10	9
7	15	8	8
8	16	10	10
9	11	9	9
10	11	10	10
11	20	10	10
12	16	10	10
13	32	6	6
14	11	8	8
	$\bar{X}$ 18.43	$\bar{X}$ 9.00	$\bar{X}$ 9.21

a = blocks of twenty
b = one-day post-test
c = seven-day post-test

indicated it took significantly longer to learn the signs at 80% criterion ($p<.05$). There were no differences, however, between the groups on the post-tests ($p>.05$).

Study 9

This study was conducted at Loloma School. Ten elementary severely retarded subjects were instructed with cumulative progamming to teach them the pairing of words and numbers from 1-5 to 80% criterion. Data from this study was compared to the cumulative data from Study 10 to ascertain differences between academic and motor (pre-vocational)task. Data are presented in Table 6.

The data analysis indicated a significant difference in trials to criterion in favor of the academic task ($p<.05$). There were no differences between groups on the first and second post-test ($p>.05$).

Study 10

This study was conducted at Tonalea School. Elementary age severely retarded subjects were taught a pre-vocational sorting task using either cumulative or successive programming. The task involved size descrimination along one dimension and a motor response. Data are presented below in Table 7.

The data analysis indicated no differences between groups on trials to criterion and seven-day post-test ($p>.05$). One-day post-test scores were significantly different in favor of the cumulative group ($p<.05$).

TABLE 6

Cumulative Programming

Academic

Subject	Trials[a]	P1[b]	P2[c]
1	11	7	6
2	9	10	10
3	9	9	9
4	9	8	10
5	9	9	7
6	9	10	10
7	9	10	10
8	9	10	10
9	9	7	6
10	9	10	10
	$\bar{X}$ 9.20	$\bar{X}$ 9.09	$\bar{X}$ 8.80

Motor

Subject	Trials[a]	P1[b]	P2[c]
1	65	9	4
2	22	8	9
3	9	9	8
4	9	9	8
5	11	10	10
	$\bar{X}$ 23.20	$\bar{X}$ 9.00	$\bar{X}$ 7.80

a = blocks of twenty
b = one-day post-test
c = seven-day post-test

TABLE 7

Cumulative

Subject	Trials[a]	P1[b]	P2[c]
1	65	9	4
2	22	8	9
3	9	9	8
4	9	9	8
5	11	10	10
	$\bar{X}$ 23.20	$\bar{X}$ 9.00	$\bar{X}$ 7.80

Successive

Subject	Trials[a]	P1[b]	P2[c]
1	21	4	2
2	21	5	0
3	15	3	5
4	28	4	10
5	15	7	9
6	15	6	8
7	15	7	8
8	15	5	6
9	15	8	5
	$\bar{X}$ 17.78	$\bar{X}$ 5.44	$\bar{X}$ 5.89

a = blocks of twenty
b = one-day post-test
c = seven-day post-test

Study 11

This study was conducted at Tonalea School. Adolescent age severely retarded subjects were taught a pre-vocational sorting task using either cumulative or successive programming. The task involved size discrimination along one dimension and a motor response. Data are presented below in Table 8. The data analysis indicated a significant difference in trials to criterion in favor of the cumulative group ($p<.05$). There were no significant differences between groups on the post-tests ($p>.05$).

Study 12

This study was a comparison of cumulative programming across age levels on a pre-vocational motor task. This was accomplished by comparing the cumulative group from Study 10 with the cumulative group from Study 11. Data are presented below in Table 9. The data analysis indicated a significant difference between groups only on the one-day post-test ($p<.05$). There were no significant differences in trials to criterion and seven-day post-test ($p>.05$).

Study 13

This study was conducted at the CIDS/ESP housed at Papago School in Phoenix. Ten elementary profoundly retarded students were taught a pre-vocational assembly task requiring a motor response, using the cumulative programming technique. This study was discontinued after a year and a semester. Many of the subjects had over 1700 trials and were not progressing toward criterion. The data are presented below in Table 10.

TABLE 8

Subject	Trials[a]	P1[b]	P2[c]
Cumulative			
1	10	8	6
2	9	8	9
3	9	8	8
4	9	5	5
	$\bar{X}$ 9.25	$\bar{X}$ 7.25	$\bar{X}$ 7.00
Successive			
1	15	8	9
2	15	8	7
3	15	0	6
4	15	9	8
5	15	6	1
	$\bar{X}$ 15.00	$\bar{X}$ 6.20	$\bar{X}$ 6.20

TABLE 9

Cumulative Programming

Subject	Trials[a]	P1[b]	P2[c]
Elementary			
1	65	9	4
2	22	8	9
3	9	9	8
4	9	9	8
5	11	10	10
	$\bar{X}$ 23.20	$\bar{X}$ 9.00	$\bar{X}$ 7.80
Adolescent			
1	10	8	6
2	9	8	9
3	9	8	8
4	9	5	5
	$\bar{X}$ 9.25	$\bar{X}$ 7.25	$\bar{X}$ 7.00

a = blocks of twenty
b = one-day post-test
c = seven-day post-test

TABLE 10

Cumulative Programming

Subject	Trials[a]	P1[b]	P2[c]
1	90	9	7
2	91		
3	98	10	10
4	89		
5	88		
6	90		
7	82		
8	85		
9	89		
10	91		

a = blocks of twenty
b = one-day post-test
c = seven-day post-test

Study 14

This study was conducted at Tonalea School. Fourteen elementary severely retarded subjects were instructed with cumulative programming to teach tham manual signs for practical words. These data were compared to the cumulative data from Study 1 to ascertain differences between psychomotor and non-motor academic tasks. The data is presented below in Table 11. The data analysis indicated no significant differences between groups ($p > .05$).

Study 15

This study was conducted at Tonalea School. Fourteen adolescent severely retarded subjects were instructed with cumulative programming to teach them manual signs for practical words. Half the subjects learned to 80% criterion while the other half learned to 50% criterion. The data is presented below in Table 12.

The data analysis indicated a significant difference in trials to criterion in favor of the 50% group ($p < .05$). There were no significant differences in post-test performance ($p > .05$).

In summary, it can be seen that our studies were directly related to the stated project objective of investigating variables related to the subject, the content, and the task.

TABLE 11

Cumulative Programming

Sight Words

Subject	Trials[a]	P1[b]	P2[c]
1	29	10	10
2	20	4	6
3	20	10	9
4	18	8	10
5	12	9	9
6	11	7	8
7	10	10	10
8	10	10	7
9	9	10	10
10	9	10	10
11	9	10	10
	$\bar{X}$ 14.27	$\bar{X}$ 8.91	$\bar{X}$ 9.00

Signs

Subject	Trials[a]	P1[b]	P2[c]
1	31	9	10
2	18	10	10
3	33	9	9
4	12	8	10
5	17	9	10
6	15	10	9
7	15	8	8
8	16	10	10
9	11	9	9
10	11	10	10
11	20	10	10
12	16	10	10
13	32	6	6
14	11	8	8
	$\bar{X}$ 18.43	$\bar{X}$ 9.00	$\bar{X}$ 9.21

a = blocks of twenty
b = one-day post-test
c = seven-day post-test

TABLE 12

Cumulative Programming

80%

Subject	Trials[a]	P1[b]	P2[c]
1	15	8	8
2	16	10	10
3	11	9	9
4	11	10	10
5	20	10	10
6	16	10	10
7	11	8	8
	$\bar{X}$ 14.29	$\bar{X}$ 9.29	$\bar{X}$ 9.29

50%

Subject	Trials[a]	P1[b]	P2[c]
1	9	10	10
2	9	10	10
3	9	10	10
4	9	10	10
5	9	10	10
6	9	10	10
7	9	10	10
	$\bar{X}$ 9.00	$\bar{X}$ 10.00	$\bar{X}$ 10.00

a = blocks of twenty
b = one-day post-test
c = seven-day post-test

Dissemination

The project dissemination activities served as the major forum for discussion of project study results and their utility for classroom/traing setting implementation and the direction of future research. As indicated in the project timeline, dissemination took place over three-years and was quite extensive. A summary of dissemination activities is presented below:

Local dissemination workshops/staff training were conducted at the following sites:

Loloma School	- Scottsdale
Getz School	- Tempe
Arizona Preschool	- Phoenix
Montebello School	- Phoenix
Papago School	- Phoenix
Rich School	- Phoenix
Tonalea School	- Scottsdale
Tolleson Elementary	- Tolleson

National dissemination presentations/workshops were as follows:

Presented: Zucker, S. H. & Prehm, H. J. Cumulative versus successive programming with severely retarded students. The Gatlinburg Conference on Research in Mental Retardation/ Developmental Disabilities, Gatlinburg, Tennessee, March, 1981.

Presented: Zucker, S. H. & Prehm, H. J. Alternative teaching strategies for severely handicapped students. Annual Meeting of the American Association on Mental Deficiency, Detroit, May, 1981.

Session Moderator: Instruction of the Severely/Profoundly Retarded. Annual Meeting of the American Association on Mental Deficiency, 1981.

Panelist: National Workshop Conference on Vocational and Employment Opportunities for the Mentally Retarded. President's Committee on Mental Retardation, Madison, Wisconson, March, 1982.

Presented: Zucker, S. H. & Prehm, H. J. Research on instructional strategies for severely/profoundly retarded students. Annual Meeting of the Council for Exceptional Children, Houston, Texas, April, 1982.

Chair: Session on Mental Retardation. Annual Meeting of the Council for Exceptional Children, Houston, Texas, April, 1982.

Presented: Zucker, S. H. & Prehm, H. J. Durability of training among severely retarded children as a function of teaching strategy. The Gatlinburg Conference on Research in Mental Retardation/Developmental Disabilities, Gatlinburg, TN, April, 1982.

Session Moderator: Research Symposium on Educational Programming for the Moderately and Severely Retarded. Annual Meeting of the American Association on Mental Deficiency, Boston, June, 1982.

Presented: Zucker, S. H. & Prehm, H. J. Cumulative teaching strategies for increasing the retention of severely retarded handicapped students. Annual Meeting of the American Association on Mental Deficiency, Boston, June, 1982.

Presented: Zucker, S. H. Stability of response choice of severely retarded children. The Gatlinburg Conference on Research in Mental Retardation/Developmental Disabilities, Gatlinburg, TN, March, 1983.

Chair: Session on Mental Retardation. Annual Meeting of the Council for Exceptional Children, Detroit, April, 1983.

Presented: Zucker, S. H. & Prehm, H. J. Effects of two teaching strategies on acquisition and retention among severely retarded students. Annual Meeting of the Council for Exceptional Children, Detroit, April, 1983.

Presented: Zucker, S. H. & Prehm, H. J. Instructional research on retention of information among severely retarded students. Annual Meeting of the American Association on Mental Deficiency, Dallas, June, 1983.

Presented: Zucker, S. H. Cumulative teaching strategies for severely retarded students. Southeast Regional Resource Center, Juneau, Alaska, September, 1983.

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APPENDIX A

DATA SHEET - SUCCESSIVE PAIRS PROGRAMMING

Subject: a= d=

Date: b= e=

Experimenter: c=

Directions: circle each correct answer, cross-out each wrong answer.

STEP 1		STEP 2		STEP 3		STEP 4		STEP 5		STEP 6		STEP 7	
a	a	b	b	ab	ab	c	c	ac	ac	d	d	ad	ad
a	a	b	b	ba	ba	c	c	ca	ca	d	d	da	da
a	a	b	b	ab	ab	c	c	ac	ac	d	d	ad	ad
a	a	b	b	ba	ba	c	c	ca	ca	d	d	da	da
a	a	b	b	ab	ba	c	c	ac	ca	d	d	ad	da
a	a	b	b	ab	ab	c	c	ac	ac	d	d	ad	ad
a	a	b	b	ba	ab	c	c	ca	ac	d	d	da	ad
a	a	b	b	ba	ab	c	c	ca	ac	d	d	da	ad
a	a	b	b	ab	ba	c	c	ac	ca	d	d	ad	da
a	a	b	b	ab	ab	c	c	ac	ac	d	d	ad	ad

STEP 8		STEP 9		STEP 10		STEP 11		STEP 12		STEP 13		STEP 14	
e	e	ae	ae	bc	bc	bd	bd	be	be	cd	cd	ce	ce
e	e	ea	ea	cb	cb	db	db	eb	eb	dc	dc	ec	ec
e	e	ae	ae	bc	bc	bd	bd	be	be	cd	cd	ce	ce
e	e	ea	ea	bc	cb	bd	db	be	eb	cd	dc	ce	ec
e	e	ae	ea	cb	cb	db	db	eb	eb	dc	dc	ec	ec
e	e	ae	ae	bc	bc	bd	bd	be	be	cd	cd	ce	ce
e	e	ea	ae	cb	bc	db	bd	eb	eb	dc	cd	ec	ce
e	e	ea	ae	cb	bc	db	bd	be	be	dc	cd	ec	ce
e	e	ae	ea	bc	cb	bd	db	be	eb	cd	dc	ce	ec
e	e	ae	ae	bc	bc	bd	bd	eb	be	cd	cd	ce	ce

STEP 15	
de	de
ed	ed
de	de
de	ed
ed	ed
de	de
ed	de
ed	de
de	ed
de	de

POSTTEST: a c d a b

e d b e c

DATA SHEET - CUMULATIVE PROGRAMMING

Subject: a= d=

Date: b= e=

Experimenter: c=

Directions: circle each correct answer, cross-out each wrong answer.

STEP 1		STEP 2		STEP 3		STEP 4		STEP 5		STEP 6		STEP 7	
a	a	b	b	ab	ab	c	c	bca	acb	d	d	cadb	cbda
a	a	b	b	ba	ba	c	c	cab	bca	d	d	dcab	badc
a	a	b	b	ab	ab	c	c	bac	bac	d	d	bacd	cdba
a	a	b	b	ba	ba	c	c	acb	cab	d	d	dcab	abcd
a	a	b	b	ab	ba	c	c	bca	cba	d	d	dbac	abcd
a	a	b	b	ab	ab	c	c	abc	bca	d	d	dabc	bdac
a	a	b	b	ba	ab	c	c	cba	cab	d	d	cbda	dcab
a	a	b	b	ba	ab	c	c	bca	acb	d	d	abdc	badc
a	a	b	b	ab	ba	c	c	abc	abc	d	d	cdba	dcab
a	a	b	b	ab	ab	c	c	cab	acb	d	d	dcba	abcd

STEP 8		STEP 9	
e	e	adbce	debca
e	e	dbcea	daceb
e	e	edcba	dacbe
e	e	adcbe	abdce
e	e	bdcae	daecb
e	e	bcead	cadeb
e	e	adecb	ceadb
e	e	cbdea	abced
e	e	edcba	baced
e	e	adcbe	bedca

POSTTEST: a c d a b e d b e c